

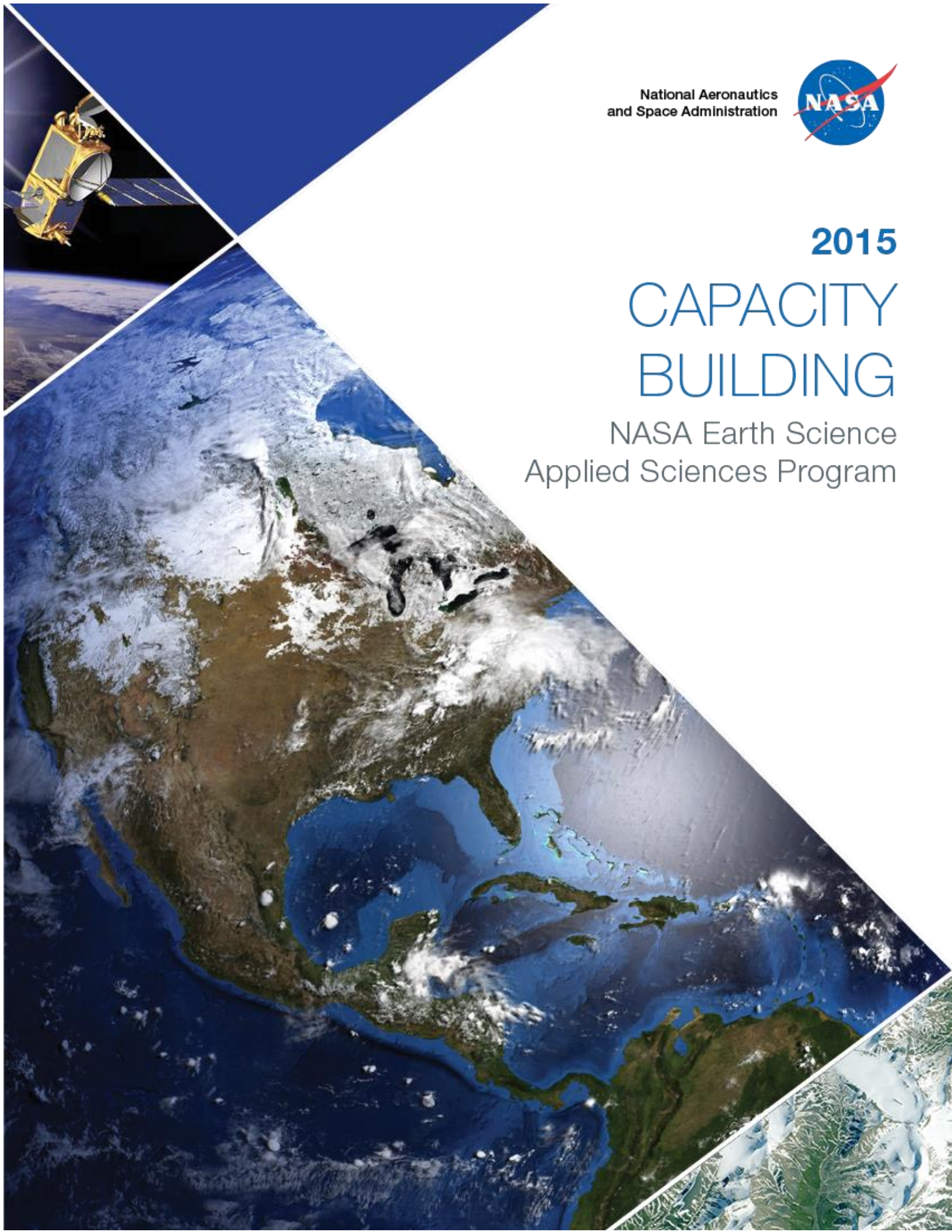
National Aeronautics
and Space Administration



2015

CAPACITY BUILDING

NASA Earth Science
Applied Sciences Program



NASA ASP Capacity Building Program 2015 Calendar Year Summary

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I. Introduction

The Earth Science Division's (ESD) Applied Sciences Program (ASP) promotes efforts to discover and demonstrate innovative and practical uses of Earth observations. ASP activities partner with organizations from the public and private sectors to apply scientific findings and satellite data in their decision-making activities. The Program has two primary lines of business: Applications and Capacity Building. All Program activities support goals to deliver near-term uses of Earth observations, build capabilities to apply Earth science data, and contribute to satellite mission planning.

The Applied Sciences Capacity Building Program (CBP) builds capacity within the United States and the developing world to 1) expand the Earth observations user base and 2) increase the awareness within non-traditional audiences of NASA Earth observations data and products. CBP builds capacity across the Societal Benefit Areas of the Group on Earth Observations (GEO).

The Capacity Building Program works through both program and element activities. Program activities include participating in both domestic and international capacity building groups, such as the GEO and the Committee on Earth Observation Satellites (CEOS) as well as identifying partnership opportunities to reach new end-users. Program element activities include Applied Remote Sensing Training (ARSET), DEVELOP, and SERVIR.

Element Descriptions

ARSET conducts training in the use of NASA remote sensing resources for environmental applications worldwide. The program works directly with agencies and policy makers to develop in-person and online trainings that teach end users how to access, visualize, and apply NASA Earth Science Data in their professional area. Modules and webinar recordings are publicly available in English and Spanish on the program website. To access the training materials, join the listserv, and learn about upcoming activities, please visit <http://arset.gsfc.nasa.gov/>.

DEVELOP addresses environmental and public policy issues by conducting interdisciplinary feasibility projects that apply the lens of NASA Earth observations to community concerns around the globe. Bridging the gap between NASA Earth Science and society, DEVELOP builds capacity in both participants and partner organizations to better prepare them to address the challenges that face our society and future generations. With the competitive nature and growing societal role of science and technology in today's global workplace, DEVELOP is fostering an adept corps of tomorrow's scientists and leaders. To learn more about DEVELOP, view previous projects, and propose a project idea, please visit <http://develop.larc.nasa.gov/>.

SERVIR, a joint development initiative of NASA and the United States Agency for International Development (USAID), works in partnership with leading regional organizations world-wide to help developing countries use information provided by Earth observing satellites and geospatial technologies for improving resilience to climate change. SERVIR empowers decision-makers with tools, products, and services to act locally on climate-sensitive issues. SERVIR is improving awareness, increasing access to information, and supporting analysis to help people in Africa, Hindu Kush-Himalaya, Mekong, and Central America manage challenges in the areas of food security, water, disasters, land use/land cover, ecosystems, weather, and climate. For more information, visit www.servirglobal.net/.

II. 2015 Overview

In 2015, the Capacity Building Program strengthened through strategic planning and management initiatives, increased productivity, and broadened geographic reach. The Gulf of Mexico Initiative (GOMI) was completed successfully, and DEVELOP closed nodes in Stennis, Mississippi; Richmond, Virginia; and Kathmandu, Nepal. CBP expanded with a SERVIR Mekong hub in Thailand, a DEVELOP node in Pocatello, Idaho, and more application area training topics offered by ARSET.

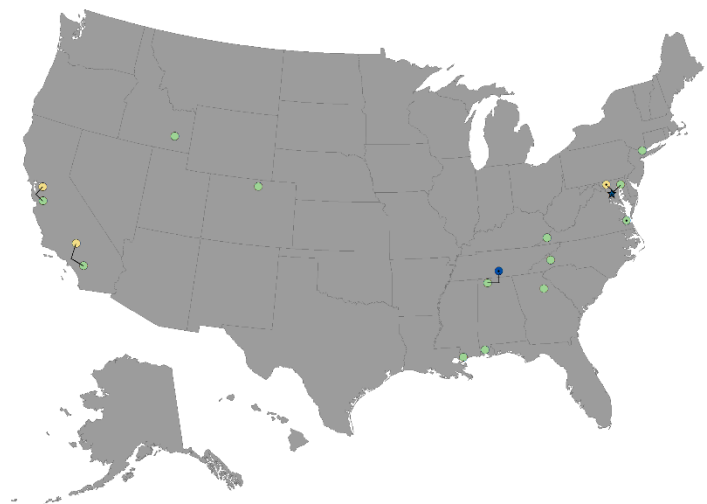
CBP held a Strategic Planning Workshop in March 2015 to review mission and objectives, finalize indicator tracking methodologies, assess baselines, set targets, and develop a five-year strategic plan. This allowed CBP to pilot the tracking of shared indicators to monitor progress program-wide and within each element, in an effort to enhance and improve monitoring and evaluation, to track progress, and to adapt CBP offerings based on what is learned.

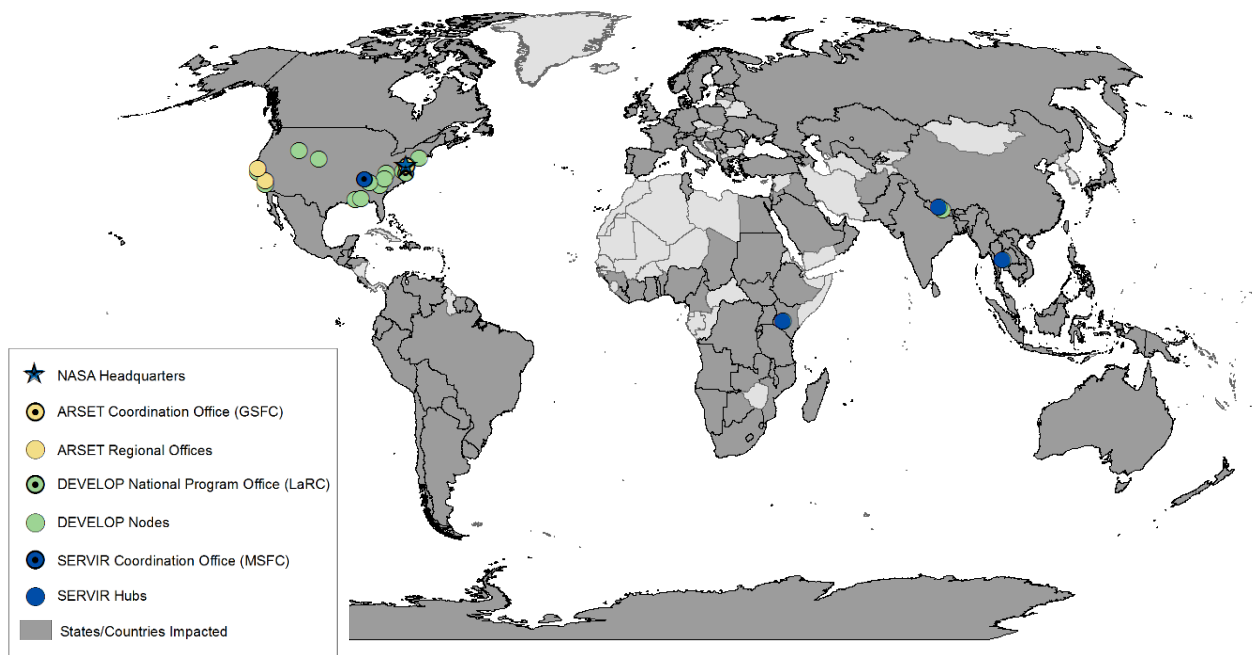
The five-year strategic plan was developed to serve as a roadmap for the program into the year 2020. This plan identified five strategic goals and related objectives and actions:

- I.** Expand the network of individuals and institutions aware of and able to access NASA Earth observations.
- II.** Increase the capabilities of individuals and institutions to use and apply NASA Earth observations in their management decisions and actions.
- III.** Enable sustained use of existing NASA Earth observations for decisions and actions, and the ability to incorporate new observations as they become available.
- IV.** Build skills of the Earth sciences community to define end-user needs, collect and share robust feedback, build capacity, and assess impact of capacity building activities.
- V.** Improve feedback of lessons learned through capacity building to Earth science research and analysis, applications, and data systems program management.

The Capacity Building Program engaged more than 4,000 people this year. CBP trained more than 3,330 people through webinars and in-person trainings, 381 people through on-demand trainings, and 393 people through participation in feasibility projects. In total, these individuals were engaged in 78 trainings, 93 feasibility projects, and 47 longer-term SERVIR projects. The CBP collectively used 67 Earth-observation assets in trainings and projects.

Geographic coverage serves as an indicator of the program activities' breadth, including project study areas and locations of end-users and individuals engaged in CBP activities. As seen in the maps below, ARSET offices, DEVELOP nodes, and SERVIR hubs are distributed across the U.S. and abroad. The maps also show that in 2015, CBP worked in 50 U.S. states (an increase of three states from 2014) and 135 countries (an increase of 28 countries from 2014).





III. Accomplishments & Highlights

2015 By the Numbers

Who?

People Trained: 4,104

Stakeholders Using Information in Decision Making: 193

Organizations Engaged: 1,369

(See Breakout of Organizations in Appendix)

What?

Trainings Given: 78

Feasibility Projects Conducted: 93

Longer-Term SERVIR Projects: 47

Number of Earth Observation Assets Used: 67

(See Earth Observation Assets List in Appendix)

Number of Application Areas, plus Cross-Cutting: 10

(See Breakout of Application Areas in Appendix)

Where?

U.S. States, Territories, & Possessions Impacted: 50 States + 7 Territories + DC

Countries Impacted: 135

Communications

Journal Publications: 20

(See Publications List in Appendix)

Conferences, Meetings, & Workshops Attended: 68

NASA Earth Science Division Event Participation: 25

Programmatic Accomplishments

The Capacity Building program's characterization of its impact continued to expand in 2015. Based on pilot program-level indicators, we are now tracking the overall program as shown above – by the numbers. Feedback from those trained through ARSET and those that participate in DEVELOP projects are being regularly collected and reviewed to improve our offerings. Iterative SERVIR workshops with end-users - from initial inception workshops, to feedback, to training workshops - ensure the products are co-developed based on end-user needs. The Program continued integrating and leveraging activities between program elements as well. The elements agreed on common indicators and collaborated as described in the Program Management section below.

In preparation for the Earth Sciences Decadal Survey, two workshops were held to collect feedback about applications and capacity-building needs in developing countries. In addition to workshop reports, white papers were submitted to the Decadal Survey process, and journal articles were published.

The Capacity Building team continues to interact with the science community at conferences such as the American Geophysical Union (AGU) Fall Meeting, where the team presented its results and chaired sessions in addition to organizing social activities to strengthen relationships. At the Esri International Users Conference, potential users were introduced to the value of NASA data through booth presentations. Overall, CBP participated in a total of 68 conferences and 25 NASA meetings in 2015.

Each of the CBP elements had a great year in 2015 as well. Their major accomplishments are described below.

In 2015, ARSET reached more individuals, organizations and countries than in any previous single year. In fact, there were 2,877 participants - more than in all previous years combined - from 1,032 organizations and 123 countries who attended trainings. ARSET had a number of firsts in 2015. Trainings reached participants in each of the 50 U.S. states for the first time. The previous record for live webinar attendance was broken twice in the year: first by a flood management webinar and then by a water-resource management webinar. To keep up with training demands, ARSET began posting on-demand webinars on the fundamentals of remote sensing. The program also added an additional focus area on wildfire, and collaborated with several organizations and NASA programs to host the first two wildfire trainings.

DEVELOP had its largest year to date with 393 participants conducting 93 projects in collaboration with 157 partner organizations that impacted all U.S. states and 28 countries. The program continued its 'Virtual Poster Session' series highlighting the use of Earth observations in decision making, which had a record 29,304 YouTube views. A new DEVELOP location opened in Pocatello, Idaho, expanding the program's reach in the Northwest. DEVELOPers presented their research at 43 science and policy conferences, where they chaired three sessions and increased awareness of the applications of NASA Earth observations. The program continued its military engagement initiative through increased outreach to veterans' organizations and new tracking mechanisms for gathering the number of veterans engaged in the program. DEVELOP also launched DEVELOPedia, an internal resource for the program's 15 locations to utilize and collaborate with improved archiving and sharing of institutional knowledge.

With activities in 39 countries to date, SERVIR has developed 63 decision-support products and tools, and trained more than 2,800 people in their use. These products and tools operate based on data from 22 different satellites/sensors. In 2015, SERVIR developed, provided oversight for, enhanced, or launched, 47 applications and tools, including geoportals to improve data

availability and sharing, online agricultural atlases to support food security, and vulnerability assessment tools to inform disaster-related decisions. A total of 834 people were trained in the use of SERVIR tools, technologies, data, and methodologies. With SERVIR's help, an estimated 128 institutions saw improvements in their capacity to address climate change issues.

Highlight Events & Activities

The Capacity Building Program's activities are best illustrated by highlighting events and activities that brought Earth observations to decision makers. The following are some of the top highlights for 2015:

The Capacity Building Program partnered with The Carter Center in response to a request from President Carter to Administrator Bolden asking for assistance in locating the villages of an indigenous tribe in the Amazon rainforest, in order to support eradication of onchocerciasis. A DEVELOP team, supported by SERVIR, used NASA and NGA data to identify potential village locations in remote areas of the Amazon. The team was able to identify multiple villages previously unknown to the Venezuelan government, which allowed health professionals to pursue medical treatment efforts in their goal to eradicate onchocerciasis from the region.

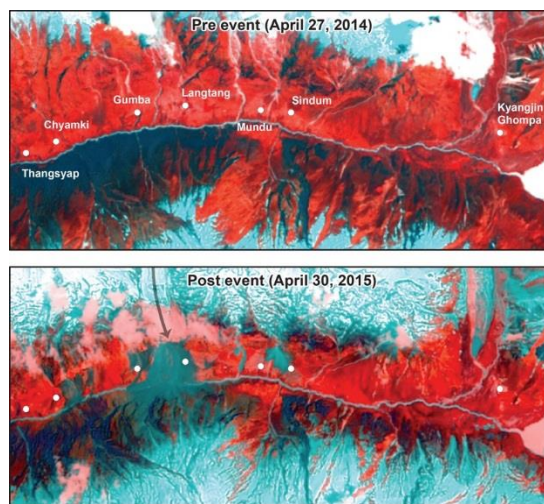


ARSET hosted a training focused on data product applications from a single mission, the Global Precipitation Measurement (GPM) mission. The course covered GPM's data, its applications to water resource management and flooding, and the advantages of the transition from Tropical Rainfall Measuring Mission (TRMM) measurements to GPM. There were 288 participants from 62 countries.

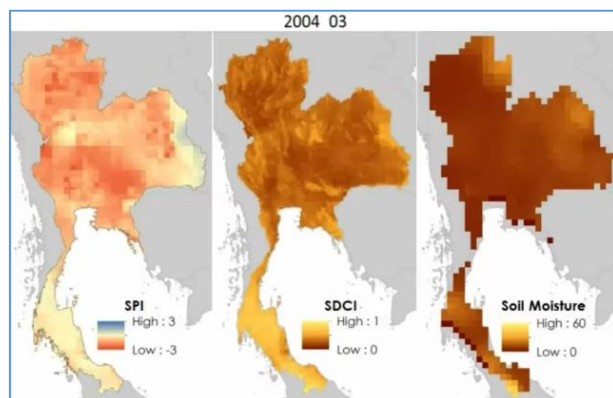
In May, ARSET hosted its first webinar for the conservation community, which featured regional and global observation resources for conservation management. It was tailored to the needs of professionals in conservation management, with a focus on remote-sensing tools and how to maximize their efficacy. There were 293 participants from 270 organizations and 61 countries.

In the aftermath of the devastating April 2015 Gorkha, Nepal earthquake, SERVIR team members in Nepal and the U.S. acquired and interpreted large volumes of satellite imagery to support disaster response and inform decision making. SERVIR engaged with the broader NASA disasters response community including volunteer scientists. Their work was published in a paper highlighting the new understanding of the Earth system gained from this tragic event.

On 31 August 2015, the latest SERVIR hub -- SERVIR-Mekong -- was launched. NASA Administrator Charlie Bolden, NASA Chief Scientist Ellen Stofan, USAID RDMA Director Beth Paige, and many SERVIR team members from around the world attended the launch event. SERVIR-Mekong, funded by USAID and NASA and implemented by the Asian Disaster Preparedness Center (ADPC) and its partners, is promoting the use of satellite imagery to



help governments and other key decision-makers in Asia's Lower Mekong region better predict and cope with floods and other natural disasters and increase resilience to the negative effects of climate change. Countries served are Burma, Cambodia, Lao PDR, Thailand, and Vietnam.



DEVELOP's summer term saw the most projects (38) ever conducted by the program in one term. These projects were highlighted in August at DEVELOP's Annual Earth Science Applications Showcase at NASA Headquarters. Agency senior management attended and spoke, and numerous project end-users attended and participated in an end-user panel discussing the benefits of using NASA Earth science data in their work.

Through a partnership with the Royal Thai Embassy, 10 Thai students studying in the U.S.

participated in DEVELOP, working on two projects focused on using NASA Earth observations to support decision making in the Kingdom of Thailand related to drought and agriculture health monitoring. These projects not only built capacity in the project participants, but also provided new tools for the country to assess and predict climatic impacts to agricultural yields and respond to drought.

The Virginia Governor's Office highlighted the achievements of their partnership with DEVELOP with a press release showcasing the Commonwealth's use of NASA data in state-level decision making. DEVELOP's Virginia Agriculture project utilized Earth observations to support vineyard monitoring throughout the state. As a result, the project was highlighted by the *Washington Post* and *Modern Farmer* and the Virginia Wine Board gained a new classification scheme for identifying vineyards throughout the state into the future.

Program Assessment

At the program level, CBP has continued to focus on understanding how others build capacity to use Earth observations through workforce training and project collaborations. A session at the AGU Fall Meeting was organized to discuss best practices for building skills to use Earth observations, and to also identify ways others are monitoring their activities to show that they are indeed building capacity. This is a work in progress and will be continued into the spring of 2016 at a capacity-building summit in conjunction with the CEOS Working Group for Capacity Building and Data Democracy. The program continues to consider how to gauge outcomes, in addition to measurement outputs such as numbers of trainees, trainings, and projects.

The Program continued strengthening connections between each of the program elements, to the Applied Sciences Program application areas, and to other parts of the Earth Science Division. In addition to water issues, hazards and disasters are being discussed from basic research, applied science, and capacity-building perspectives. The Capacity Building team participated in Applied Sciences applications area annual meetings, science team meetings, and mission applications workshops for upcoming missions. In addition, the Program continued to contribute, and is working to more clearly define contributions to and from international organizations, including CEOS and GEO.

IV. Community Engagement

Community Leadership

In 2015, Capacity Building presented and led sessions in national conferences, interagency and international events, as well as supported workshops to provide inputs into the Earth Sciences Decadal Survey.

CBP chaired a session at the AGU Fall Meeting in San Francisco, California entitled: "Best Practices for Improving Workforce Skills to Use Earth Observations in Environmental Management and Policy Posters." The session brought together a broad community of capacity-building groups to discuss best practices for improving workforce skills to use Earth observations in environmental management and policy.

DEVELOP chaired a session at the Association of American Geographers' Annual Meeting in Chicago, Illinois. This session focused on highlighting the success of DEVELOP's ability to conduct rapid, interdisciplinary feasibility projects to apply NASA Earth observations to decision making globally while building capacity in participants.

DEVELOP chaired a session at the American Society of Photogrammetry & Remote Sensing Annual Conference in Tampa, Florida. This session focused on the application of data from NASA's Earth observing satellites and airborne missions to real-world environmental and policy concerns, as well as DEVELOP's unique model of rapid-feasibility projects. The session utilized a hybrid format that combined lightning-style talks and traditional oral presentations followed by a brief poster session.

In order to facilitate communication among NASA scientists, data product and tool developers, and applied science professionals, ARSET formed and organized an air quality working group (AQWG). The first meeting was held at Goddard Space Flight Center (GSFC) in November. In addition to several ARSET team members, there were 15 attendees from NASA GSFC and NASA Headquarters. The three-hour meeting included an overview of the ARSET program and brief presentations by attendees on relevant projects and potential synergies with ARSET. Action items included: working on case studies and examples to help users understand which datasets to use; sharing ARSET survey results with projects; developing ARSET trainings to help with end-user requests; and considering more training for academia (students and faculty).

The 2nd annual SERVIR Joint Working Group meeting was held in Washington, D.C., on 11 March, 2015, among USAID and NASA Headquarters Earth Science Division (ESD) leadership and SERVIR Coordination Office leadership. The SERVIR team presented accomplishments and strategies for the next five years and gained support from senior USAID and NASA management.

In preparation for the Earth Sciences Decadal Survey, two workshops – one in-person workshop hosted by Faisal Hossain from University of Washington and one virtual workshop hosted by Amy Thomas from Battelle – were held to collect feedback about applications and capacity-building needs in developing countries. In addition to workshop reports, white papers were submitted to the Decadal Survey process, and journal articles were published (Hosseini, 2015).

International Activities

The Capacity Building Program actively participated in U.S. and international Earth observations and capacity-building activities in 2015. CBP supported a wide variety of activities that engaged Central and South American organizations and government agencies, including the Centre of Hydrologic and Spatial Information for Latin America and the Caribbean webinar series, Latin American Geospatial Forum, GEO Americas Caucus Meeting, and Americas Coordination

Group monthly meetings. Nancy Searby serves as the NASA representative on the USGEO International Activities Working Group, as well as co-chair of the USGEO Americas Coordination Group, NASA representative on the GEO water capacity building task team, and NASA representative on the CEOS Working Group for Capacity Building and Data Democracy.

Initially conceived at an Americas Caucus meeting in October 2014, the AmeriGEOSS initiative was developed in 2015, endorsed by the Americas Caucus and launched at the GEO-XII Plenary and Ministerial meeting in Mexico City in November 2015.

For all ARSET participants in 2009-2015, international professionals comprised 43 percent of attendees. In 2014, 60 percent of attendees were international, and in 2015, that number rose to 65 percent of attendees. ARSET reached participants in 34 new countries over the course of the year.

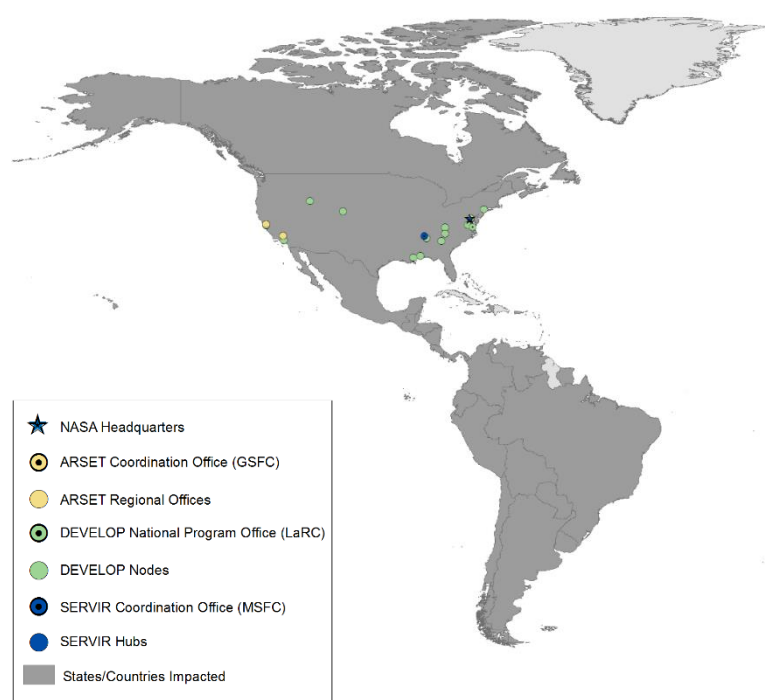
While DEVELOP's focus is U.S. capacity building, the program conducts internationally located projects and engages international participants studying in the U.S. on feasibility projects. In 2015, international projects were 25 percent of the project portfolio and international participants were 10.4 percent of the participant population.

SERVIR is inherently international, working in partnership with leading regional organizations around the globe to help developing countries use information provided by Earth observing satellites and geospatial technologies for managing climate risks and land use. SERVIR was able to engage 34 countries through the support of the regional hubs. In addition, SERVIR Applied Sciences Team (AST) projects engaged seven countries in Mesoamerica.

To help understand and assess international activities, CBP assesses international activities by the GEO Regional Caucus to identify regions that have benefited most from the Program's capacity building.

Americas

CBP engaged with 29 countries in the Americas through ARSET webinars and in-person trainings, DEVELOP rapid feasibility projects, and SERVIR Applied Sciences Team projects.



In May, ARSET hosted its second in-person training in Cartagena, Colombia for 26 environmental professionals. The training focused on building capacity to use NASA remote sensing observations and tools to monitor seasonal to interannual climate variability and assessing impacts on hydrology and flooding over South America.

DEVELOP conducted 12 non-U.S. projects in this region. These projects focused on decision support related to shifting crop zones in Peru, human health risks in Puerto Rico and the Amazon, forest cover dynamics in El Salvador, drought impacts on

agriculture in Uruguay, water budget and management in Peru and Costa Rica, and endangered species habitat in Colombia.

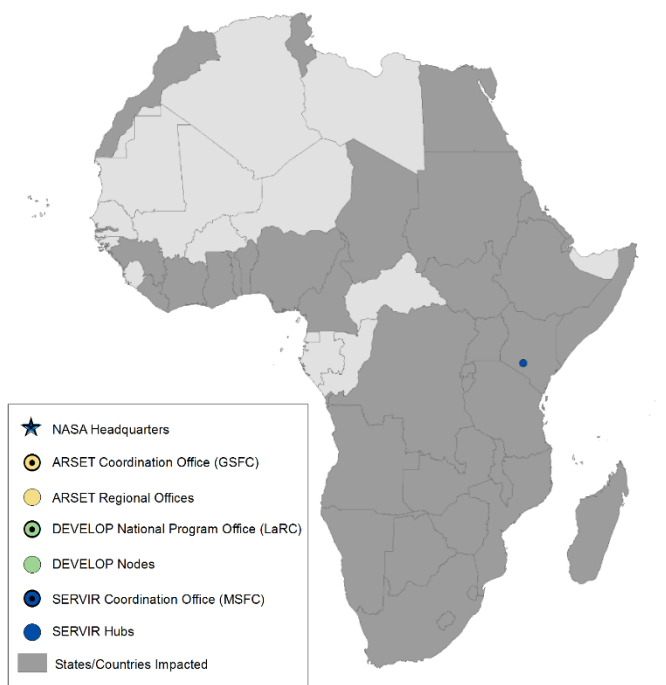
SERVIR engaged seven countries in the Americas through their Applied Sciences Team projects focused on the issues of landslide hazards, air quality monitoring and forecasting, and REDD+ policy making.

Africa

CBP reached 37 countries through ARSET webinars, DEVELOP rapid feasibility projects, and SERVIR's hub in Nairobi, Kenya.

Working with hub host organization, the Regional Center for Mapping of Resources for Development (RCMRD) in Nairobi, Kenya, SERVIR-Eastern and Southern Africa serves 24 countries in the region. The program empowers regional decision-makers with tools, products, and services to monitor critical changes in water levels, weather conditions, land cover, and more, so they can manage risks more effectively.

DEVELOP conducted six projects in this region, which addressed community concerns ranging from flood detection and forecasting in Malawi and Botswana, algal bloom monitoring in Lake Victoria, habitat conservation management in Ethiopia, and landslide-hazard mapping in East Africa.

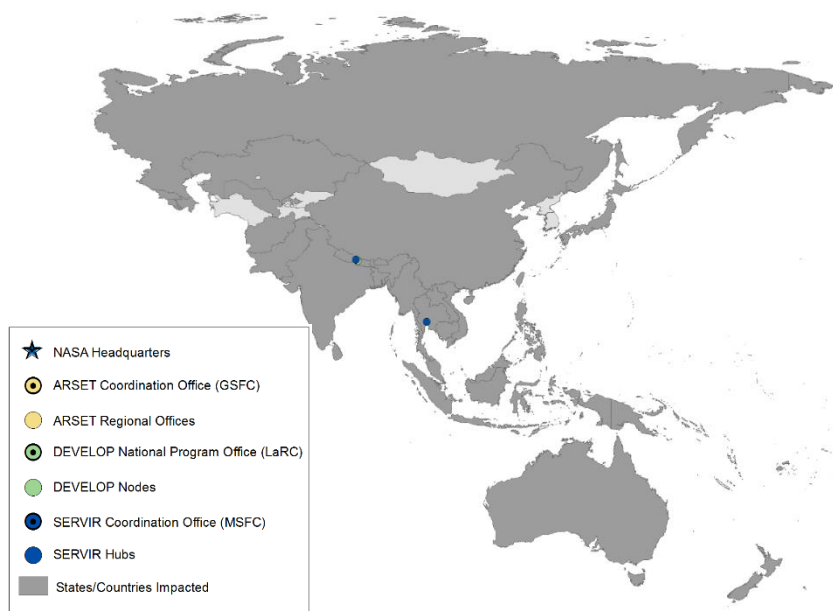


Asia and Oceania

CBP increased activity in Asia and Oceania through ARSET webinars, DEVELOP rapid feasibility projects, and SERVIR's hubs in Kathmandu, Nepal, and Bangkok, Thailand. Thirty-one countries were reached through ARSET webinars, DEVELOP rapid feasibility projects, and SERVIR hub engagement.

Working with hub host organization, the International Centre for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal, SERVIR-Himalaya serves five countries in the Hindu Kush-Himalaya (HKH) region. The program empowered regional decision-

makers with tools, products, and services to monitor critical changes in water levels, weather



conditions, land cover, and more, so they can manage risks more effectively. SERVIR-Himalaya strengthened ICIMOD's capabilities as an established regional resource center on geospatial information and Earth observation applications for the HKH region.

SERVIR-Mekong is implemented by the Asian Disaster Preparedness Center (ADPC) and its consortium partners - Spatial Informatics Group; Stockholm Environment Institute; and Deltares. ADPC is a leading regional resource center on disaster risk reduction and climate change adaptation in Asia, and has strong partnerships with national governments in the region. With support from its development partners, ADPC provides more than 20 countries with technical services and capacity building to build resilience against natural hazards in the most disaster-prone region of the world. SERVIR-Mekong serves Cambodia, Lao PDR, Burma, Thailand, and Vietnam.

In April, ARSET hosted a webinar that featured NASA and NOAA air quality data products, including live demonstrations on accessing NASA data. The training had a large percentage of international attendees - 82 percent compared to the ARSET average of 65 percent - and focused on case studies for Southeast Asia.

DEVELOP conducted six projects in this region. These projects supported decision making related to agriculture in Thailand, landslides in the Himalayas, and wildfires in Indonesia.

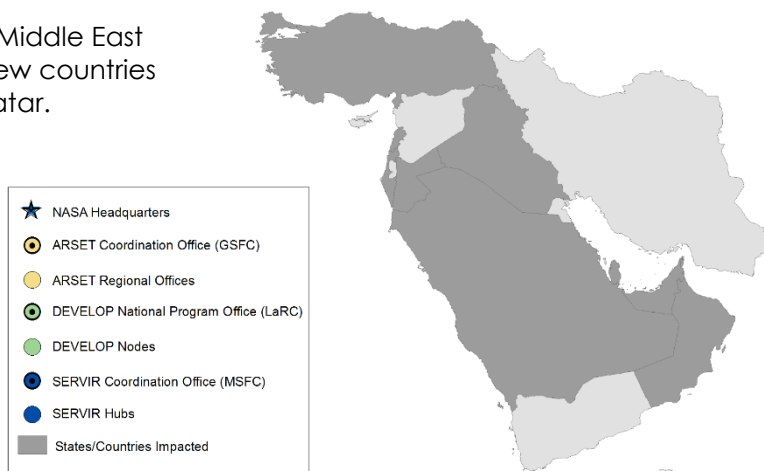
Europe

CBP reached 29 countries in Europe through ARSET webinar trainings, an increase of 11 new countries (Bosnia and Herzegovina, Croatia, Denmark, Estonia, Finland, Hungary, Iceland, Kosovo, Luxembourg, Slovenia, and Ukraine) compared to 2014.



Middle East

CBP engaged nine countries in the Middle East through ARSET webinars, with two new countries engaged since 2014: Oman and Qatar.



Data Accessibility

To increase the capabilities of individuals and institutions to use and apply NASA Earth observations, CBP has continued efforts to improve data discovery, access, and management.

A significant fraction of ARSET trainings are dedicated to improving data access. On average for 2015, 94 percent of training survey respondents indicated that an ARSET training improved their ability to access NASA remote-sensing data products either somewhat or a great deal. ARSET improved access to data from the following missions/instruments: AIRS, CALIPSO, GPM, Jason-2, Landsat, MISR, MODIS, MOPITT, OMI, SRTM, TRMM, and VIIRS. Trainings featured either demonstrations or hands-on activities on the use of web-based tools that provide access to NASA data. The following web-based tools were demonstrated in 2015: Aerostat/MAPSS, Earth Observatory, FIRMS MODIS active fires, LANDFIRE, Giovanni, Global Data Explorer, Global Flood Monitoring System, Global Forest Watch, GloVis, LAADSWeb, LandsatLook Viewer, LifeMapper, Mirador, MRTWeb, MODIS NRT Flood Mapping, Precipitation Processing System STORM, RECOVER, USDA-FAS-Crop Explorer, USGS Earth Explorer, Worldview, and WELD.

DEVELOP continued efforts to expand access to tools and results created by its feasibility projects through a publicly available ArcGIS Online story map gallery and a GitHub gallery of data processing tools. In 2015, “dnppy” (DEVELOP National Program python module) was made public and has a collection of functions and classes for downloading, formatting, and analyzing NASA satellite data and ancillary datasets. Two other python scripted tools were made public: M-SRM (Modified Snowmelt Runoff Model, which forecasts snowmelt in Chile) and METRIC (which estimated daily evapotranspiration using Landsat imagery).

SERVIR enhanced data access through the standardization of 421 data layers that it made public during 2015, and completed a redesign of its website (www.servirglobal.net) which provides more efficient access to SERVIR's resources. The site geo-locates SERVIR's products, data, and news so users can view, at a glance, SERVIR's activities in a given country. The new website is part of SERVIR's ongoing efforts to enhance the quality and availability of products and information offered to interested individuals and organizations worldwide. SERVIR's hubs also improved and expanded their websites and regional geoportals, increasing access to data products and services (RCMRD/SERVIR-Eastern & Southern Africa: <http://www.rcmrd.org/servir-eastern-southern-africa/> and <http://apps.rcmrd.org>; ICIMOD/SERVIR-Himalaya: <http://geoportal.icimod.org> and <http://rds.icimod.org>; ADPC/SERVIR-Mekong: <http://servir.adpc.net> and <http://index.servirmekong.opendata.arcgis.com>). The SERVIR hubs also supported the development of national geoportals in Ethiopia, Rwanda, South Sudan, Swaziland, Nepal, and Bhutan to enable data access and dissemination.

V. Program Management

Management Team

Capacity Building is led by Dr. Nancy Searby at NASA Headquarters. In 2015, the Program was supported by Merna Saad, Sarah Hemmings, Georgina Crepps, and Lauren Childs-Gleason, who served as liaisons between the program elements and NASA Headquarters. Each element was led by management teams at NASA Centers: ARSET – Dr. Ana Prados, UMD at GSFC; DEVELOP – Michael Ruiz, LaRC; and SERVIR – Dan Irwin, MSFC.

Collaborative Activities

The Capacity Building Program is highly integrated and efficiently leverages activities between program elements. In 2015, the program deepened its collaboration through new lines of communication between the elements:

- DEVELOP and SERVIR collaborated on six international feasibility projects spanning three continents (Africa, Asia, and South America) and co-hosted Thai scholars at Marshall Space Flight Center.
- ARSET enhanced communication to DEVELOP and SERVIR by announcing upcoming webinar-based trainings, which led to an increased number of DEVELOP and SERVIR hub participants engaged in ARSET trainings that support project research.
- DEVELOP supported ARSET's in-person wildfire training in Idaho in October.
- ARSET identified a feasibility project focused on air quality that was then conducted by DEVELOP's Goddard node.
- GOMI supported SERVIR on two projects addressing needs of the new Mekong hub.

Strategic Planning

Capacity Building continues to strengthen through enhancement of programmatic assessment methods and tools. In March 2015, CBP management and elements gathered in Washington, D.C., to conduct a Strategic Planning Workshop. Participants reviewed past and current missions and objectives, discussed indicator tracking methodologies, assessed baselines, set targets, and developed a five-year strategic plan.

CBP also has an internal program management goal to enhance activities that promote and improve engagement, entrepreneurship, and evaluation.

- **Engagement.** CBP will pursue approaches that increase connectivity with current partners, reach out to potential end users, and engage Earth scientists who may be interested and skilled in applications. By improving programmatic understanding of key needs and user preferences, new communities will be targeted and engaged.
- **Entrepreneurism.** Through experimentation and adoption of innovative methods for building capacity, CBP will implement the Program's strategy to include creative approaches to data access, idea generation, brokering connections, funding of projects, use of social media and community challenges, and reporting of outcomes. A focus on creative solutions that increase effectiveness and expand the reach of the program will also be highlighted.
- **Evaluation.** Monitoring and evaluation through the tracking of indicators across all elements will be performed. This activity includes the creation and refinement of results frameworks for each element and the program as a whole, as well as the identification and collection of shared indicators across all elements. Improved monitoring will increase efficiency and assist with identification of highlights and successes.

In November 2015, the ARSET team held a strategic planning meeting at NASA JPL. The team refined and clarified categories of trainings, began the process for creating a "best practices" manual, revised the criteria for selecting training activities, and generated new ideas for increased engagement.

The 2nd annual SERVIR Joint Working Group (JWG) meeting took place in Washington, D.C., in March 2015 among USAID and NASA Headquarters ESD leadership, and SERVIR Coordination Office leadership. The JWG affirmed each agency's near-term ability to accommodate planned SERVIR growth and confirmed the strategic directions for SERVIR. A new SERVIR strategic plan was drafted and then signed by both NASA and USAID leadership. The four SERVIR goals stated in the new Strategic Plan are: 1) Reach More Users with Demand-Driven Products and Services, 2) Connect More Innovative and Appropriate Science to SERVIR, 3) Expand SERVIR Networks Through New Strategic Partnerships, and 4) Improve Sustainability of SERVIR at Multiple Levels.

In December 2015, the DEVELOP leadership team, consisting of the National Program Office, Senior Fellows, Fellows, and Center Leads, gathered for a leadership retreat in December to discuss the strategic goals for DEVELOP for the next three years. The retreat culminated in the program's strategic plan through 2018 and identified two goals: 1) Enhance the participant and partner experience and quality of project outcomes, and 2) strengthen DEVELOP's connectivity with participants, partners and broader community.

Assessment

The CBP has collected outcomes through success stories, highlights, and ARSET surveys. Indicators are being used to track intermediate results.

Indicator Tracking

Performance tracking is conducted through results frameworks that identify unique indicators for each element, with a refined number of program-wide indicators collected across all Program elements. Multiple workshops focused on building results frameworks have established a foundation of indicators for each element. Elements collect metrics annually, and sets of shared indicators are compiled for CBP as a whole.

In 2015, each element and CBP began adjusting their results framework with a focus on the simplification of Intermediate Results (IRs) and sub-IRs, and the creation of shared indicators. The Program piloted a results framework and set of indicators for 2015 and determined that the previous tracking timeline was too frequent for longer-term activities like SERVIR projects, and thus will adapt the approach in 2016.

The Program identified a set of shared indicators piloted and collected across all elements for 2015. These indicators are reported by all elements and then aggregated for the program. Their refinement will continue in 2016.

Strategic Targets

Each element addresses strategic goals and contributes to the objectives through specific targets and activities. Targets were identified in the March strategic planning workshop and piloted for 2015.

ARSET

Activity	2015 Target	2015 Actual
U.S. States Impacted	40	50
Countries Impacted	90	123
Total # of Participants	1500	2877
Total # of Organizations	500	1032
Participants Per Webinar	300	300
Participants Per In-Person Training	25-30	32
Application Areas Covered	4	4

DEVELOP

Activity	2015 Target	2015 Actual
U.S. States Impacted	35	50

International: Domestic Project Ratio	1:4	1:4
Total # of Participants	250	393
Total # of Partner Organizations	75	157
Total # of Projects	60	93
Application Areas Covered	9 (All)	9

SERVIR

Activity	2015 Target	2015 Actual
Countries Directly Served	43	43
Products Developed	40	47
Total # of PI Leads	11	11
Total # of Participants (Stakeholder Receiving Training)	397	834
Total # of Organizations with Improved Capacity	106	128
USG Science Expertise Connections	6	6

Project Tracking

Capacity Building tracks projects through two measurements: SERVIR AST's long-term projects are tracked using the Application Readiness Level (ARL) scale which begins at 1 (basic research) and continues to a 9 (sustained use of tool); and DEVELOP feasibility projects are tracked using the Project Strength Index (PSI).

ARL Metrics for Projects in 2015:

SERVIR AST ARL Range: **5 – 7**

SERVIR AST ARL Mean: **6.36**

SERVIR AST ARL Mode: **7**

of Projects with ARL 1-3: **0**

of Projects with ARL 4-6: **6**

of Projects with ARL 7-9: **5**

% of Projects Advanced 1+ ARL in past 12 months: **100%**

PI Name	Project Title	End ARL		
		Start ARL 2012	As of 2015	Goal ARL 2016
Hossain	A Satellite-based Early Warning, Mapping and Post-Disaster Visualization System for Water Resources of Low-lying Deltas of the Hindu Kush-Himalayan region	1	7	9
Robertson	Leveraging CMIP5 and NASA / GMAO Coupled Modeling Capacity for SERVIR East Africa Climate Projections	1	5	7

Thomas	Applications of Satellite Products for Air Quality Monitoring, Analysis, Forecasting, and Visualization in the SERVIR Mesoamerica and Himalaya Regions	4	7	8
Kargel	Interdisciplinary science applications to glacier and alpine hazards in relation to development and habitation in the Hindu Kush-Himalaya: SERVIR Science Team project	1	7	7
Ceccato	Development and Implementation of Flood Risk Mapping, Water Bodies Monitoring and Climate Information for Disaster Management and Human Health (integration within SERVIR)	1	6	6
Kirschbaum	Landslide Hazard Assessment and Forecasting System using near real-time remote sensing information over SERVIR-Mesoamerica	2	6	7
Blackman	Using Earth Observation Data to Improve REDD+ Policy in Mesoamerica and the Dominican Republic	1	6	7
Verdin	A Long Time-Series Indicator of Agricultural Drought for the Greater Horn of Africa	2	7	7
Goetz	Forest carbon assessment for REDD in the East Africa SERVIR region	3	6	7
Granger	East Africa Drought and Agricultural Productivity Assessment and Prediction System	2	6	9
Valdes	SERVIR Water Africa-Arizona Team (SWAAT)	1	6	7

DEVELOP tracked and assessed its feasibility projects by means of the PSI. In an effort to improve objectivity and merit of DEVELOP projects, the program utilized the PSI to track the progress of projects across a five-point scale of 1) Basic Research, 2) Application Concept Complete, 3) Application Demonstration Successful, 4) Application Verified/End-User Engaged, and 5) Transition to End-User/Decision Enhanced. This scale takes into consideration both the scientific merit of the work, as well as the project's applicability to decision making and partner capacity building. In 2015, six percent of projects reached the highest stage of being transitioned to end-users, 31 percent of projects engaged end-users and verified applications, 47 percent of projects successfully demonstrated applications to end-users, 31 percent of projects completed an application concept, and only two percent of projects were limited to basic research.

VI. Looking Ahead

In 2016, the Capacity Building Program will continue its pursuit of increasing the number of people able to use Earth observations in their decision making through its interagency and international engagements with CEOS, GEO, and others, and through its three elements: ARSET, DEVELOP, and SERVIR.

ARSET will expand its advanced online trainings, develop a manual on best practices, and engage in social media. Key activities for DEVELOP in 2016 will be the Annual Earth Science Applications Showcase in August, a participant and project collaboration with the Embassy of Costa Rica during the summer term, and multiple projects partnering with the National Park Service in support of their centennial celebrations throughout 2016. SERVIR will implement a new global organizational strategy, identify and engage Subject Matter Experts (SMEs), Technical

Advisory Groups (TAGs), SERVIR AST, and international initiatives to support and enhance hub projects, and will also launch a West Africa hub.

Focused on its five strategic goals, CBP will continue to evolve and strengthen as it refines methods for tracking progress and impact. The program will continue to conceive of ways to make Earth science data, products, and tools more known and accessible, while working with boundary organizations that can help increase reach through organizations' previous engagement with key end user groups. CBP will also explore increasing awareness within non-traditional audiences, such as indigenous people of North America.

And finally, Capacity Building management will continue to work with the program element teams to ensure that they have the resources to continue their mission to do great work and to integrate and benefit from each other's work.

VII. Appendix

Abbreviations and Acronyms

AGU: American Geophysical Union
AIRS: Atmospheric Infrared Sounder
AQWP: Air Quality Working Group
ARL: Application Readiness Level
ARSET: Applied Remote Sensing Training
ASP: Applied Sciences Program
AST: Applied Sciences Team
CALIPSO: Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation
CBP: Capacity Building Program
CEOS: Committee on Earth Observation Satellites
CIEHLYC: Comunidad para la Información Espacial e Hidrográfica para Latinoamérica y el Caribe
dnppy: DEVELOP National Program python module
FIRMS: Fire Information for Resource Management System
GEO: Group on Earth Observations
GIS: Geographic Information System
GloVIS: USGS Global Visualization Viewer
GPM: Global Precipitation Measurement
GRACE: Gravity Recovery and Climate Experiment
GSFC: Goddard Space Flight Center
HKH: Hindu Kush-Himalaya region
JPL: Jet Propulsion Laboratory
JWG: Joint Working Group
LAADSWeb: Level 1 and Atmosphere Archive and Distribution System
LANDFIRE: Landscape Fire and Resource Management Planning Tools Project
LaRC: Langley Research center
MISR: Multi-angle Imaging SpectroRadiometer
MODIS: Moderate Resolution Imaging Spectrometer
MRTWeb: MODIS Reprojection Tool Web Interface
MODIS NRT: (MODIS) Near Real-Time
MOPITT: Measurements Of Pollution In The Troposphere
MSFC: Marshall Space Flight Center
NASA: National Aeronautics and Space Administration
NOAA: National Oceanic and Atmospheric Administration
OMI: Ozone Measuring Instrument
PI: Principal Investigator
PSI: Project Strength Index
RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery
SAR: Synthetic Aperture Radar
SME: Subject Matter Expert
SRTM: Shuttle Radar Topography Mission
STORM: Science Team Online Resource
Suomi NPP: Suomi National Polar-orbiting Partnership
TAG: Technical Advisory Group
TRMM: Tropical Rainfall Measuring Mission
VIIRS: Visible Infrared Imaging Radiometer Suite
USDA-FAS: United States Department of Agriculture - Foreign Agricultural Service
USGEO: U.S. Group on Earth Observations
USGS: United States Geological Survey
WELD: Web-enabled Landsat Data
WGCapD: Working Group for Capacity Building and Data Democracy

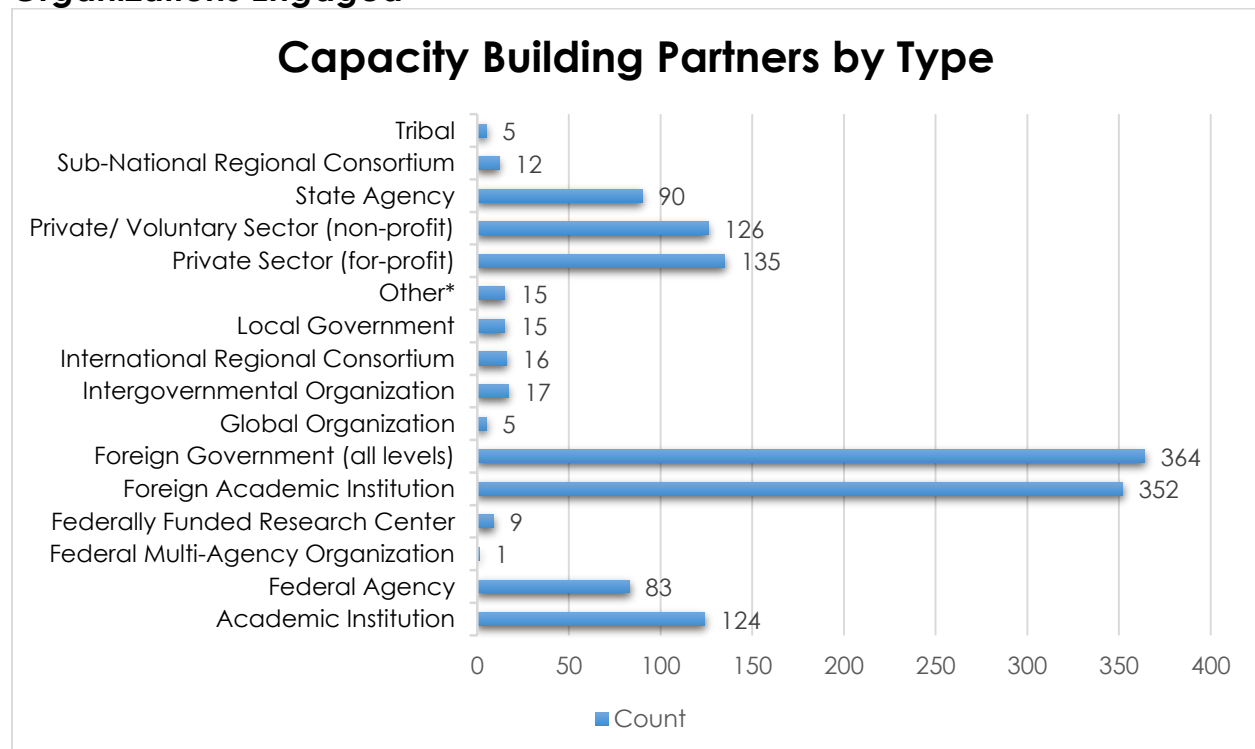
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Earth Observation Assets Employed by CBP

ALOS PALSAR	GPM DPR	Radarsat-2
AltiKa	GPM GMI	SeaStar SeaWiFS
Aqua AIRS	GRACE	Sentinel-1
Aqua AMSR-E	ICESat (GLAS)	Simulated HypSIIRI
Aqua AMSU-A	ICESat-2	SMAP Radar and Radiometer
Aqua MODIS	IKONOS	SMOS MIRAS
Envisat ASAR	Jason Altimeter	SRTM (Space Shuttle)
ASCAT	Jason-2	Suomi NPP VIIRS
Aura OMI	Jason-3	Terra ASTER
AVHRR	Landsat 1 MSS	Terra CERES
CALIPSO	Landsat 2 MSS	Terra MISR
CLARS	Landsat 3 MSS	Terra MODIS
CMORPH-CDR	Landsat 4 TM	Terra MOPITT
DMSP SSM-I	Landsat 5 TM	TerraSAR-X
EO-1 ALI	Landsat 7 ETM+	TRMM PR
ER-2 AVIRIS/MASTER	Landsat 8 OLI	TRMM TMI
ER- 1	Landsat 8 TIRS	TRMM VIRS
ERS-2	LIS	UAVSAR
EUMETSAT METOP	Meteosat	WorldView 1
GeoEye 1	PERSIANN-CDR	WorldView 2
GeoEye 2	QuickBird	WorldView
GOES	QuikSCAT	
GOSAT	RADARSAT-1	

Organizations Engaged



Capacity Building Activities by Application Area

